REMARKS/ARGUMENTS

The amendments set forth above and the following remarks are responsive to the points raised by the Office Action dated June 20, 2006. In view of the amendments set forth above and the following remarks, reconsideration is respectfully requested.

Claims 1-8 are currently pending. Claims 1, 2, 7, and 8 have been amended to describe the invention more clearly. No new matter has been added, and the basis for the amended claim language may be found within the original specification, claims, and drawings. The amendments to claims 1, 2, 7, and 8 are supported at, for example, page 6, line 24 to page 7, line 15; page 8, lines 20-30; page 10, line 20 to page 11, line 13; page 13, line 4 to page 14, line 23 of the specification, as well as Figures 1-3, 6, 11-12, and 20.

Claims 1-2 and 7-8 were rejected under 35 U.S.C. § 102 as anticipated by U.S. Patent No. 6,645,851 to Ho et al. (hereinafter, "Ho").

Claims 3-6 were rejected under 35 U.S.C. § 103 as unpatentable over Ho in view of U.S. Patent No. 5,792,680 to Sung et al. (hereinafter, "Sung").

Each of these rejections is separately and respectfully traversed.

The presently claimed invention relates to a method for manufacturing a semiconductor device, and more particularly, to a method for protecting the bottom of an opening in an interlayer of a semiconductor device against subsequent processing in forming a capacitor or in a dual Damascene process. The claimed method advantageously overcomes several problems posed by conventional methods in protecting the bottom of openings having a small aspect ratio, a shallow depth, or a large area. Conventional methods in which resist is left at the bottom of an opening having a small aspect ratio nay also leave resist on the upper portion of an insulating film around the opening. Removing the resist on the insulating film may also undesirably remove the protective resist at the bottom of the opening (specification, page 1, line 16 to page 2, line 14).

The presently claimed methods, however, protect the bottom of an opening in an interlayer of a semiconductor device while avoiding the above problems of conventional methods (page 2, line 17-23). The claimed methods advantageously form a protective resist pattern so that portions of a rough-surfaced polymer film positioned on regions other than the opening portion necessary for the formation of a capacitor can be removed by etching. For example, even if the opening is deep or has a large area, the resist on the polysilicon within the opening may be left by use of a positive photoresist while the resist on the polysilicon

film around the opening may then be removed, thus improving the reliability of the capacitor electrode forming process and the stability of the semiconductor device, regardless of the structure of the opening (specification, page 7, lines 16-24; see also page 8, line 31 to page 9, line 8; page 11, lines 14-21; and page 14, lines 24-31).

Amended independent claims 1-2 and 7-8 each recite, *inter alia,* patterning the resist film substantially in the same form as the opening by exposing the resist with a photomask having a light-shielding portion or a light-transmitting portion substantially in the same form as the opening and developing the resist, thereby burying the resist film inside of said opening. As shown in Figures 4-5, the resist 117 left in the opening 13 protects the portions of a rough-surface polymer 15 inside the opening 13 while the portions of the rough-surface polymer 15 outside the opening may be removed by etching (specification, page 7, lines 5-13).

Anticipation requires that the cited reference disclose each and every element of the claim. In this case, the anticipation rejection of amended independent claims 1-2 and 7-8 over Ho cannot be maintained because Ho does not disclose each and every element of amended independent claims 1, 2, 7, and 8.

Ho discloses a process in which a first photoresist is coated on a substrate and baked at or slightly above its Tg so that it reflows and fills the holes in the substrate. The photoresist is exposed without a mask at a dose that allows the developer to thin the photoresist to a recessed depth within the holes. After the photoresist is baked, a second photoresist is coated on the substrate. The second photoresist may be used to form a trench pattern in a via by a first dual damascene method (Ho, abstract).

Ho does not disclose exposing the resist with a photomask having a light-shielding or a light-transmitting portion substantially in the same form as the opening in the interlayer film, thereby burying the resist film inside the opening, as claimed in amended claims 1-2 and 7-8. Ho discloses forming a dielectric layer 12 on a substrate that is patterned to generate holes 13a-13e (col. 5, lines 40-43). Ho further discloses the deposition of a photoresist layer 14 on dielectric film 12 (col. 5, line 64 – col. 6, line 6; Figure 2) and further discloses that the photoresist layer 14 is "blanket exposed *without* a patterned mask" (col. 6, lines 39-40; Figure 3, emphasis added). Because the photoresist 14 of Ho is not exposed with a photomask as claimed, photoresist 14 cannot meet the amended independent claims.

Ho also discloses the deposition of a second photoresist layer 15 on the dielectric layer 12 that covers the holes 13a-13e in the dielectric film 12 and which is patternwise exposed through a mask to form trench openings 16a, 16b, 16c (col. 7, lines 25-44, Figure 5). However, photoresist 15 is not buried inside of any opening in the dielectric film 12, as claimed in the amended independent claims. As shown in Figure 6, photoresist 15 is not buried inside any of the openings 13a-13e in the dielectric layer 12, nor is the photoresist 15 buried inside of the trenches 16a-16c. Because photoresist 15 is not buried inside an opening of an interlayer film, as claimed in the amended independent claims, photoresist 15 cannot meet the resist of the amended independent claims.

Ho further discloses that the unexposed portions of the photoresist layer 15 serve as an etch mask during a plasma etch to transfer the trench pattern partially through dielectric layer 12. Amended claims 1, 2, 7, and 8 require exposing a resist with a photomask. Because an etch mask is not a photomask, and because photoresist 15 is not patterning a resist film, but dielectric film 12, photoresist layer 15 does not meet the photomask element of the amended independent claims.

For the reasons set forth above, Ho does not disclose exposing the resist with a photomask having a light-shielding or a light-transmitting portion substantially in the same form as the opening in the interlayer film, thereby burying the resist film inside the opening, as claimed in amended claims 1-2 and 7-8. Moreover, in contrast to the presently claimed methods, the method of Ho would not be effective in protecting a resist in an interlayer opening having a low aspect or a large opening. Ho therefore does not disclose each and every element of the amended independent claims, and accordingly, the anticipation rejection cannot be maintained.

Since the independent claims are allowable for the reasons set forth above, the dependent claims are also allowable because they depend from the allowable independent claims.

Dependent claims 3-6 are also allowable, not only because they depend from the allowable independent claims 1 and 2, but because they also define limitations not taught by any of the cited references. A *prima facie* case of obviousness requires that the cited combination of references teach each and every element of the claims. In this case, the cited combination of Ho and Sung does not teach every element of dependent claims 3-6. Accordingly, the obviousness rejection cannot be maintained.

Dependent claims 3 and 4 recite patterning a positive resist with a photomask having a light-shielding portion smaller in area than the opening, and dependent claims 5 and 6 recite patterning a negative resist with a photomask having a light-transmitting portion smaller in area than the opening. None of the cited references, either alone or in combination, teach a light-transmitting (or light-shielding) portion of a photomask smaller in area than the opening in the interlayer film, as claimed.

The Office Action correctly acknowledges that Ho does not disclose that the light shielding portion of the positive mask is smaller in area than the opening or that the light-transmitting portion of the negative mask is smaller in area than the opening. The Office Action cites Sung as disclosing that the transparent portions of the mask for the positive resist or the opaque portions of the mask for the negative resist are smaller in dimension than the pattern formed in the photoresist. According to the Office Action, it would have been obvious for a skilled person to modify Ho by employing smaller dimensioned mask-transmitting and mask-opaque areas as suggested by Sung because Ho exposes the resist via a mask such that resist is only left in the via holes and Sung discloses that using a mask pattern of smaller dimension results in a decrease in pitch distance, e.g., increases pattern density.

Sung teaches forming pillars in a photoresist using a photolithography mask with a pattern of small spaced transparent (or opaque) areas that are smaller than the photo resolution of the lithography tool (col. 14, lines 17-21). Sung teaches that due to the mask pattern and tool resolution, the exposed photoresist pattern is not completely defined. Instead of a shape-defined photoresist pattern, a wave-like photoresist pattern results as shown in Figure 12B (col. 14, lines 48-52).

Sung does not teach patterning a photoresist using a photomask having a light-shielding (or light-transmitting) portion that is smaller in area than an opening in any interlayer film, as claimed in claims 3-6. In contrast, Sung teaches using a photomask with a light-shielding (or light-transmitting) portion that is smaller than the resolution of a lithography tool, not of any opening in any interlayer film. Sung is actually silent regarding the size of the light-shielding (or light-transmitting) portions with respect to any particular opening in an interlayer film. Because there is no discussion in Sung about the size of any openings in an interlayer film and how they relate to the size of the light-shielding (or light-transmitting) portions of a photomask, there can be no teaching guiding anyone skilled in the art to use a photomask having a light-shielding (or light-transmitting) portion that is smaller

than the opening in the interlayer film, as claimed. Thus, Sung does not teach or suggest the claim limitation that the light-shielding (or light-transmitting) portion of the photomask is smaller than the opening in the interlayer film, as claimed. Because the combination of Ho and Sung does not teach all of the elements of dependent claims 3-6, the obviousness rejection cannot be maintained.

Moreover, using a photomask with a light-shielding (or light-transmitting) portion that is smaller than the resolution of the lithography tool to make pillars in a photoresist is an application very far removed from the use of a photomask having a light-shielding (or light-transmitting) portion smaller in area than the opening in the interlayer film to bury the resist film inside of an opening in the interlayer, as claimed in claims 3-6. Resist film buried in an opening in the interlayer film is formed to protect the bottom of an opening against subsequent processing in the formation of a capacitor, unlike the process of Sung, which forms pillars in a photoresist to form pillar-shaped storage electrodes (col. 14, lines 6-11).

The present claims are allowable over the cited references for the reasons set forth above. Reconsideration and allowance of the claims is respectfully requested.

If, in the opinion of the Examiner, a telephone conference would expedite the prosecution of the subject application, the Examiner is invited to call the undersigned attorney.

Respectfully submitted,

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Date: Nov. 20, 2006